AUTOMATED SLIDING USER DOORS AND DOOR MECHANISMS FOR A DISPENSER

BACKGROUND OF THE INVENTION

Automated dispensers are currently used to dispense items ranging from food items, to beverages, to clothing items. However, there is a need for improved dispensers that, for example, consume less space, cost less to manufacture, include fewer parts, and/or operate more efficiently than current dispensers.

SUMMARY OF THE INVENTION

In one embodiment of the invention, a drive mechanism for moving a sliding door relative to an enclosure comprises a drive assembly that includes: (1) a first drive subassembly that is adjacent a first lateral side of the sliding door; and (2) a second drive subassembly that is adjacent a second lateral side of the sliding door. The drive mechanism further includes a door linking assembly that is configured to be moved between: (1) a first position, in which the door linking assembly is positioned to link the sliding door to the drive assembly and thereby allow the drive assembly to slide the sliding door relative to the enclosure; and (2) a second position, in

which the door linking assembly is not positioned to link the sliding door to the drive assembly. In one embodiment of the invention, the first and second doors are positioned in a substantially vertical array.

In a particular embodiment of the invention, the door linking assembly comprises a rotatable member that is adapted so that when the door linking assembly is in the first position, the rotatable member is in a first angular orientation in which the rotatable member engages the drive assembly so that the drive assembly is in driving engagement with the sliding door. In this embodiment, when the door linking assembly is in the second position, the rotatable member is in a second angular orientation in which the rotatable member does not engage the drive assembly in a manner that causes the drive assembly to be in driving engagement with the sliding door. In one embodiment of the invention, the rotatable member (which may, for example, be substantially U-shaped or V-shaped) is adapted so that when the door linking assembly is in the second position, the rotatable member engages a restricting member adjacent the sliding door. This may serve to prevent users from opening the sliding door.

A dispenser according to another embodiment of the invention comprises a plurality of compartments, each of the compartments defining an interior portion and an opening through which a user may access items stored within the interior portion. In this embodiment, the dispenser further comprises a first sliding door that is positioned to selectively restrict access to a first one of the compartments by sliding between a first-door closed position, in which the first sliding door prevents users from accessing an interior portion of the first compartment, and a first-door open position, in which the first sliding door allows users to access the interior portion of the first compartment. In one embodiment, when the first sliding door is in the first-door closed position, the first sliding door is positioned in front of an access opening of the first

compartment. Similarly, in a particular embodiment, when the first sliding door is in the first-door open position, the first sliding door is positioned substantially below the access opening of the first compartment.

In this embodiment of the invention, the dispenser further comprises a second sliding door that is positioned to selectively restrict access to a second one of the compartments by sliding between a second-door closed position, in which the second sliding door prevents users from accessing an interior portion of the second compartment, and a second-door open position, in which the second sliding door allows users to access the interior portion of the second compartment. In one embodiment, when the second sliding door is in the second-door closed position, the second sliding door is positioned in front of an access opening of the second compartment. In a particular embodiment, when the second sliding door is in the second-door open position, the second sliding door is positioned substantially above the access opening of the second compartment.

In one embodiment of the invention, the dispenser includes a third sliding door that is positioned to selectively restrict access to a third one of the compartments by sliding between a third-door closed position, in which the third sliding door prevents users from accessing an interior portion of the third compartment, and a third-door open position, in which the third sliding door allows users to access the interior portion of the third compartment. In this embodiment, when the third sliding door is in the door-compartment closed position, the third sliding door is positioned in front of an access opening of the third compartment. In a particular embodiment, when the third sliding door is in the third-door open position, the third sliding door is positioned substantially above the access opening of the third compartment.

In one embodiment of the invention, the dispenser includes a single drive assembly that is adapted to: (1) move the first door between the first-door open position and first-door closed position; (2) move the second door between the second-door open position and second-door closed position; and (3) move the third door between the third-door open position and third-door closed position.

A dispenser according to a further embodiment of the invention comprises a plurality of compartments, each of the compartments defining an interior portion and an opening through which a user may access items stored within the interior portion. In this embodiment, the dispenser further comprises a first sliding door that is associated with a first one of the compartments and that is positioned to selectively restrict access to the first one of the compartments by sliding, in a substantially vertical direction, between: (1) a first-door closed position in which the first sliding door prevents users from accessing an interior portion of the first compartment; and (2) a first-door open position in which the first sliding door allows users to access the interior portion of the first compartment.

In this embodiment of the invention, the dispenser further comprises a second sliding door that is associated with a second one of the compartments and that is positioned to selectively restrict access to the second one of the compartments by sliding, in a substantially vertical direction, between: (1) a second-door closed position in which the second sliding door prevents users from accessing an interior portion of the second compartment; and (2) a second-door open position in which the second sliding door allows users to access the interior portion of the second compartment.

A dispenser according to a further embodiment of the invention comprises: (1) a compartment that defines both an interior portion and an opening through which a user may

access the interior portion; (2) a sliding door that is adapted to selectively restrict access to the compartment by sliding between a door closed position, in which the sliding door prevents users from accessing the interior portion of the compartment, and a door open position, in which the sliding door allows users to access the interior portion of the compartment; (3) a door support that is adapted to support the sliding door when the sliding door is in the door closed position, the door support being adapted to be moved from a first position in which the door support is positioned to support the door when the door is in the door closed position, and a second position in which the door support is not positioned to support the door when the door is in the door closed position; and (4) a drive mechanism that is adapted to move the sliding door from the door closed position to an intermediate position in which the door support is out of supporting engagement with the sliding door.

A method of dispensing items according to one embodiment of the invention comprises the steps of: (1) providing a first door that is adapted to selectively restrict access to a first set of one or more items by sliding in a first substantially vertical direction relative to the dispenser; and (2) providing a second door that is adapted to selectively restrict access to a second set of one or more items by sliding in a second substantially vertical direction relative to the dispenser, the second substantially vertical direction being substantially opposite the first substantially vertical direction.

A drive mechanism according to one embodiment of the invention comprises: (1) a drive assembly; and (2) a door linking assembly that is configured to be moved between: (a) a first position, in which the door linking assembly is positioned to link the sliding door to the drive assembly and thereby allow the drive assembly to slide the door relative to the enclosure; and (b) a second position, in which the door linking assembly is positioned to prevent a user from

moving the sliding door into an open position. In one embodiment of the invention, the drive assembly comprises a first drive subassembly and a second drive subassembly, and the door linking assembly links the sliding door to both the first drive subassembly and the second drive subassembly when the door linking assembly is in the first position. In a particular embodiment of the invention, the first and second drive subassemblies are disposed adjacent opposite lateral sides of the sliding door.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

Figure 1A is a perspective view of a dispenser according to one embodiment of the invention. The dispenser's user doors are shown closed.

Figure 1B is a perspective view of the dispenser of Figure 1A in which one of the dispenser's user doors is shown open.

Figure 2 is a front view of the dispenser of 1A. This figure shows the direction that each of the user doors moves when opening according to one embodiment of the invention.

Figure 3 is a cross-sectional side view of the main door of the dispenser of Figure 1A taken about Section 3-3 of Figure 2.

Figure 4 is a cross-sectional top view of the main door of the dispenser of Figure 1A taken about section 4-4 of Figure 2.

Figure 5 is a schematic view of a drive/locking system according to one embodiment of the invention. This figure shows the system in a closed and locked configuration.

Figure 6 is a schematic view of the drive/locking system of Figure 5 in which the system is in a substantially closed and unlocked configuration.

Figure 7 is a schematic view of a drive/locking system according to another embodiment of the invention in which the system is in a closed and locked configuration.

Figure 8 is a schematic view of the drive/locking system of Figure 7 in which the system is in a substantially closed and unlocked configuration and in which a support mechanism is in a first configuration.

Figure 9 is a schematic view of the drive/locking system of Figure 7 in which the system is in a substantially closed and unlocked configuration and in which the support mechanism is in a second configuration.

Figure 10 is a schematic view of the drive/locking system of Figure 7 in which the user door is moving into a substantially open and unlocked configuration.

Figure 11 is a perspective view of a drive system according to one embodiment of the invention.

Figure 12A is a front view of a drive/locking system according to a particular embodiment of the invention in which the user door is in a closed, locked configuration.

Figure 12B is an enlarged front view of the wheel shown in Figure 12A.

Figure 12C is an enlarged cross-sectional side view of the wheel shown in Figures 12A and 12B taken about section 12C-12C of Fig. 12B.

Figure 13A is side view of a left track of the dispenser shown in Figure 12A.

Figure 13B is a side view of the right track of the dispenser shown in Figure 12A.

Figure 14A is a front view of a drive/locking system according to a particular embodiment of the invention in which the user door is in a closed, unlocked configuration.

Figure 14B is an enlarged front view of the wheel shown in Figure 14A.

Figure 15 is a front view of a locking mechanism according to a further embodiment of the invention in which the user door is in a closed, locked configuration.

Figure 16A is a side view of the left track of the dispenser shown in Figure 15.

Figure 16B is a cross-sectional side view of the right track of the dispenser shown in Figure 15 taken about a section that extends vertically between the right drive chain and linking rod shown in Figure 15.

Figure 17 is a cross-sectional side view of the right side of the sliding user door shown in Figure 15 taken about a section that extends vertically between the stopper and right track of the dispenser shown in Figure 15.

Figure 18 is a front view of the locking mechanism of Figure 15 in which the user door is in a closed, unlocked configuration.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which various embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Overview of the General Structure of the Dispenser

Figures 1 – 10 provide an overview of a dispenser according to a particular embodiment of the invention. More particularly, Figure 1A depicts a dispenser **100** that comprises a body

portion **200** and a main door **300** that is preferably mounted to move relative to the body portion **200** (e.g., about hinges) to permit access to one or more interior compartments defined by the body portion **200**. This main door **300** is typically locked during operation and used to provide dispenser operators simultaneous access to all of the dispenser's interior compartments (e.g., by opening the main door **300**).

The main door **300** comprises one or more sliding user doors, which are, in one embodiment of the invention, arranged in a substantially vertical array. For example, the dispenser **100** depicted in Figure 1A includes four user doors **401** – **404** that are arranged in a substantially vertical array. In one embodiment of the invention, each user door **401** - **404** is configured to selectively restrict access to a particular compartment defined by the dispenser **100**. For example, as may be understood from Figures 1A and 1B, the second user door **402** may be moved between: (1) a closed position (shown in Figure 1A) in which the second user door **402** prevents users from accessing an interior portion of the dispenser (e.g., an interior compartment); and (2) an open position (shown in Figure 1B) in which the second user door **402** does not prevent users from accessing an interior portion (e.g., a compartment **410**) of the dispenser. In one embodiment of the invention, one or more (and preferably all) of the user doors **401-404** are adapted to slide between an open and a closed position.

As may be understood generally from Figures 1 – 3, in one embodiment of the invention, the uppermost user door (in this case, first user door **401**) is configured to open by sliding in a first direction (e.g., downwardly) and one or more of the other user doors (in this case, the second, third, and fourth user doors **402** - **404**) are configured to move in a second direction that is substantially opposite to the first direction (e.g., in this case, upwardly). This is due to the fact that the upward movement of the first user door **401** is inhibited by the top of the dispenser **300**.

To facilitate the movement (e.g., sliding movement) of the various user doors **401 - 404**, these user doors **401 – 404** may be mounted to slide along at least two different paths. For example, in the embodiment of the invention shown in Figures 3 and 4, the first and third user doors **401, 403** are mounted to slide along a first substantially vertical path, and the second and fourth user doors **402, 404** are mounted to slide along a second substantially vertical path adjacent the first substantially vertical path. In this embodiment of the invention, the first and second paths are defined by substantially vertical tracks disposed adjacent the opposite sides of the user doors **401 - 404**. Also, as may be understood from Figure 4, in this embodiment of the invention, the first and second vertical paths are each substantially planar and are substantially parallel to, and offset from, each other.

As may be understood from Figure 3, in one embodiment of the invention, the user doors **401 - 404** are arranged so that each particular user door **401 – 404**, and at least one other user door **401 – 404** adjacent that particular user door, are adapted to slide along different paths. For example, in the embodiment of the invention shown in Figure 3, the first user door **401** and the second user door **402** (which is adjacent the first user door **401**) are configured to slide along different paths. This allows the first user door **401** to slide from a closed position in which the first user door **401** is above the second user door **402**, to an open position in which the first user door **401** is immediately adjacent to and co-facing the second user door **402**. In one embodiment of the invention, when the first user door **401** is in the open position, the first and second user doors **401, 402** are substantially vertically aligned and a rear portion of the first user door **401** is adjacent a front portion of the second user door **402**.

Similarly, in one embodiment of the invention, the dispenser **100** is configured so that the second user door **402** may slide from a closed position in which the second user door **402** is

immediately below the first user door **401**, to an open position in which the second user door **402** is immediately adjacent to and co-facing the first user door **401**. In a particular embodiment of the invention, when the second user door **402** is in this open position, the first and second user doors **401**, **402** are substantially horizontally aligned and a rear portion of the first user door **401** is adjacent a front portion of the second user door **402**.

In one embodiment of the invention, when the first and second user doors **401**, **402** are both in a closed position, the first and second user doors **401**, **402** are positioned so that a user can not access items within the interior of the dispenser by reaching between the first and second user doors **401**, **402**.

Turning again to Figure 3, in one embodiment of the invention, the dispenser **100** is configured so that the third user door **403** may slide from a closed position in which the third user door **403** is below the second user door **402**, to an open position in which the third user door **403** is immediately adjacent to and co-facing the second user door **402**. In one embodiment of the invention, when the third user door **403** is in this open position, the second and third user doors **402**, **403** are substantially horizontally aligned and a rear portion of the third user door **403** is adjacent a front portion of the second user door **402**.

Also, in one embodiment of the invention, the dispenser **100** is configured so that the fourth user door **404** may slide from a closed position in which the fourth user door **404** is immediately below the third user door **403**, to an open position in which the fourth user door **404** is immediately adjacent to and co-facing the third user door **403**. In one embodiment of the invention, when the fourth user door **404** is in this open position, the third and fourth user doors **403**, **404** are substantially horizontally aligned and a rear portion of the third user door **403** is adjacent a front portion of the fourth user door **404**.

As may be understood from Figures 1-3 and the above discussion, in one embodiment of the invention, the various user doors **401-404**, and a housing (e.g., a housing formed by the dispenser's body portion **200** and the dispenser's main door **300**) cooperate to restrict access to one or more compartments defined by the dispenser **100**. It should be understood that, while this housing is described in this specification as including both the dispenser's body portion **200** and the dispenser's main door **300**, this housing may take many forms. For example, the housing may be a single integrated unit.

Overview of User Door Drive and Locking Mechanisms

Figures 5-10 depict various drive and locking mechanisms according to various embodiments of the invention. More particularly, Figures 5 and 6 depict a drive and locking mechanism that is particularly suitable for use with the second, third, and fourth user doors **402-404** shown in Figure 1. Such drive and locking mechanisms are especially suitable, for example, for use with sliding user doors that are configured for sliding upwardly from a closed to an open position (i.e., for upwardly-opening sliding user doors), or for relatively lightweight doors.

Figures 7-10 depict various drive and locking mechanisms that are particularly suitable for use with sliding user doors that are configured for sliding downwardly from a closed to an open position (i.e., for downwardly-opening sliding user doors). For example, these drive and locking mechanisms are well suited for use with the first user door **401** of Figure 1.

Turning to Figures 5 and 6, these figures depict a drive and locking mechanism according to one embodiment of the invention that is positioned for use with a user door **105**. The drive and locking mechanism comprises a drive mechanism that comprises a first drive subassembly **110** that is positioned adjacent a first lateral side of the user door **105**, and a second drive

subassembly **115** that is positioned adjacent a second lateral side of the user door **105**. The drive and locking mechanism further comprises a door linking assembly **120** that comprises an elongate linking member (e.g., linking rod **121**) and a rotatable member **134**. The drive and locking mechanism may also comprise a blocking member, which may be, for example, a wheel **125** or any other suitably shaped member. In a particular embodiment of the invention, the wheel **125** is adjacent the first lateral side of the user door **105** and rotatable member **134** is adjacent the second lateral side of the user door **105**.

As may be understood from Figure 5, the linking rod **121** is preferably mounted to slide laterally relative to the user door **105**. For example, in the embodiment of the invention shown in Figure 5, the linking rod **121** is slideably mounted to the user door **105** by one or more linking rod mounts **122**.

Similarly, the rotatable member **134** is preferably mounted to rotate relative to the user door **105**. For example, in the embodiment of the invention shown in Figure 5, the rotatable member **134** is rotatably mounted to the door by a mounting pin **137** and is substantially free to rotate about an axis defined by the mounting pin **137**.

As may be understood from Figure 5, in one embodiment of the invention, the rotatable member **134** comprises a first elongate member **140** and a second elongate member **142** that is, in one embodiment of the invention, substantially parallel to the first elongate member **140**. The rotatable member **134** may further comprise an intermediate member **135** that extends between the first and second elongate members **140, 142**. In the embodiment of the invention shown in Figure 5, the rotatable member **134** is substantially U-shaped. However, the rotatable member **134** may alternatively be V-shaped, W-shaped, or any other suitable shape.

As noted above, in one embodiment of the invention, the rotatable member **134** is configured to rotate about a mounting pin **137**. In addition, in a particular embodiment of the invention, the rotatable member **134** is linked so that moving the linking rod **121** in a first lateral direction causes the rotatable member **134** to rotate in a counterclockwise direction, and so that moving the linking rod **121** in a second lateral direction causes the rotatable member **134** to rotate in a clockwise direction. In one embodiment of the invention, the second direction is substantially opposite the first direction.

As may be understood from Figure 5, in one embodiment of the invention, the linking rod **121** is linked to wheel **125**, (which may be referred to as a blocking member), which, as discussed in greater detail below, serves to restrict the vertical movement of the user door **105** when the wheel **125** (which may be referred to as a type of "blocking member") is in a locked position, and which may also serve to facilitate the vertical movement of the user door **105** when the user door **105** is in an unlocked position. In the embodiment of the invention shown in Figure 5, the blocking member **125** is a wheel that is rotatably mounted to the linking rod **121**.

In one embodiment of the invention, the wheel **125** is attached to the linking rod **121** so that the wheel **125** is adjacent a first end of the linking rod **121**. Similarly, the rotatable member **134** is mounted to the linking rod **121** so that the rotatable member's first elongate member **140** is adjacent a second end of the linking rod **121**. In one embodiment of the invention, the wheel **125** is mounted to the linking rod **121** so that the wheel **125** is substantially free to rotate relative to the linking rod **121** about the wheel's central axis.

In a particular embodiment of the invention, when the door linking assembly **120** is in a first "locked" position, the rotatable member **134** is also in a locked position in which the rotatable member's first elongate member **140** extends adjacent (and preferably into a recess

defined by) a first restricting member **147** (which, for example, may simply be an appropriately shaped portion of the dispenser's housing) that is adjacent a first side of the door **105**. When the rotatable member **134** is in the closed position, the first restricting member **147** serves to restrict the movement of the user door **105** in the upward direction (e.g., due to the fact that the first restricting member **147** serves to physically restrict the upward movement of the first elongate member **140** and therefore the upward movement of the user door **105**).

Similarly, when the door linking assembly **120** is in the first "locked" position, the wheel **125** is also in a locked position in which the wheel **125** is positioned adjacent (and preferably below) a second restricting member **145** that is adjacent the first side of the user door **105**. This serves to further restrict the movement of the user door **105** in the upward direction (e.g., due to the fact that the second restricting member **145** serves to physically restrict the upward movement of the wheel **125** and therefore the upward movement of the user door **105**).

As will be understood from Figure 5, when the door linking assembly **120** is in the "locked" position, the rotatable member's second elongate member **142** is out of engagement with the first drive subassembly **115** and the linking rod **121** (e.g., the first linking member end portion **130**) is out of engagement with the second drive subassembly **110**. This serves to further prevent movement of the user door **105** by maintaining the user door **105** disengaged from the drive mechanism when the door linking assembly **120** is in the "locked" position.

In one embodiment of the invention, the door linking assembly **120** includes a biasing mechanism, such as a spring (not shown), for continuously biasing the door linking assembly **120** towards the "locked" position. For example, the door linking assembly **120** may include a spring (not shown) that is attached and configured for biasing the linking rod **121** so that additional force is required to move the linking rod **121** from the "locked" to the "unlocked"

position, and so that additional force is also required to maintain the linking rod **121** in the "unlocked" position.

In a further embodiment of the invention, and as shown in Figure 6, when the door linking assembly **120** is in a second, "unlocked" position, the rotatable member **134** is also in an unlocked position in which the first restricting member **147** does not substantially obstruct the upward movement of the rotatable member's first elongate member **140**. Also, in a particular embodiment of the invention, when the door linking assembly **120** is in the "unlocked" position, the rotatable member's second elongate member **142** is in driving engagement with the second drive subassembly. For example, in the embodiment of the invention shown in Figure 6, the second elongate member **142** engages a second door movement bracket **117**, which places the door linking assembly **120** into driving engagement with the second drive subassembly **115**.

Similarly, when the door linking assembly **120** is in the "unlocked" position, the wheel **125** is also in an unlocked position in which the wheel **125** is positioned so that the second restricting member **145** does not substantially obstruct the upward movement of the wheel **125**. In one embodiment of the invention, when the door linking assembly **120** is in the "unlocked" position, the wheel **125** is positioned to roll along an exterior surface of the second restricting member **145**. Also, in a particular embodiment of the invention, when the door linking assembly **120** is in the "unlocked position", a portion of the linking rod **121** (e.g., an end portion **130**) is positioned to engage a first door movement bracket **112**, which places the door linking assembly **120** into driving engagement with the first drive subassembly **110**.

To move the door linking assembly **120** from the locked to the unlocked position, the linking rod **121** is moved toward the first drive subassembly **110** (e.g., to the right in Figure 5). The linking rod **121** may be moved automatically (e.g., via an actuator) or, in an alternative

embodiment, manually. This movement of the linking rod **121** causes the rotatable member **134** to rotate about the mounting pin **137** until: (1) the rotatable member's second elongate member **142** engages the second door movement bracket **117**; and (2) the rotatable member's first elongate member **140** is positioned so that its upward movement is not substantially obstructed by the first restricting member **147**. Figure 6 depicts the rotatable member **134** in this "unlocked" position.

The movement of the linking rod **121** also causes the wheel **125** to move into a position in which the second restricting member **145** does not substantially obstruct the upward movement of the wheel **125**. In addition, the movement of the linking rod **121** preferably positions the wheel **125** so that the wheel **125** may roll along an exterior edge of the second restricting member **145** as the user door **105** is moved from a closed to an open position. The movement of the linking rod **121** also serves to move the end **130** of the linking rod **121** into engagement with the first door movement bracket **112** (and, thus, into engagement with the first drive subassembly **110**).

The user door **105** may then be opened by using the first and second drive chains **111**, **116** (or other drive members) to move the first and second door movement brackets **112**, **117** (and, thus, the user door **105**) upwardly until the user door **105** reaches an open position. The user door **105** may then be closed by using the first and second drive chains **111**, **116** (or other drive members) to move the first and second door movement brackets **112**, **117** (and, thus, the user door **105**) downwardly until the user door **105** reaches a closed position. Once the user door **105** is in the closed position, the linking rod **121** is moved toward the second drive subassembly **115** until the door linking mechanism **120** is again in the locked position described above.

It should be understood that one feature of the embodiment of the invention shown in Figure 6 is that, when the door linking mechanism **120** is in the locked position, the rotatable member's first elongate member **140** and the first restricting member **147** serve to maintain the second lateral side of the user door **105** in the closed position. At the same time, the wheel **125** and the second restricting member **145** serve to maintain the first lateral side of the user door **105** in the closed position. In one embodiment of the invention, this serves to prevent users from gaining access to the contents of the dispenser by moving the first or the second lateral side of the user door **105** upwardly when the user door **105** is in the locked position.

It should also be understood that in a particular embodiment of the invention, a single actuator may be used to: (1) lock and unlock the user door **105**; and (2) move the user door **105** into and out of engagement with a drive mechanism that is adapted to open and close the user door **105**.

User Door Drive and Locking Mechanisms with Door Support Assembly

Figures 7-10 depict a door drive and locking mechanism that is particularly useful with sliding user doors (such as the first sliding user door **401** shown in Figures 1-3) that open downwardly. As may be understood from Figure 7, this door drive and locking mechanism comprises a door linking mechanism, such as the door linking mechanism **120** described above in regard to Figures 5 and 6. The door drive and locking mechanism also comprises a door support assembly **150** that is configured for supporting the weight of the user door **106** when the user door **106** is in a closed position.

As may be understood from Figures 7-10, in one embodiment of the invention, the door support assembly **150** comprises a door support member (such as the elongate door support rod

109 shown in Figure 7) that is attached to move laterally relative to the user door **106**. For example, in the embodiment of the invention shown in Figure 7, the door support rod **109** is slideably mounted to the user door **106** via two door mounts **157, 158**. In one embodiment of the invention, the door support rod **109** comprises a stopper **160** adjacent a first end of the door support rod **109**.

In a particular embodiment of the invention, the door support assembly **150** includes a biasing mechanism for continuously biasing the door support assembly **150** towards the "unlocked" position. For example, the door support assembly **150** may include a spring **162** that is attached to the user door **106** via support member **164**, and that is configured for biasing the support rod **109** so that additional force is required to move the support rod **109** from the "unlocked" to the "locked" position, and so that additional force is also required to maintain the support rod **109** in the "locked" position.

In one embodiment of the invention, a pushing member **167** is provided adjacent the first side of the user door **106** and is configured for moving between: (1) a first position in which the pushing member **167** engages the stopper **160** and exerts a force on the door support rod **109** that is sufficient to maintain the door support assembly **150** in the "locked" position; and (2) a second position in which the pushing member **167** does not engage the stopper **160** and is preferably spaced apart from the first side of the user door **106**. In one embodiment of the invention, when the pushing member **167** is in the first position, the pushing member **167** extends through an opening **180** in a first side of the user door **106**. In a particular embodiment of the invention, this opening **180** is dimensioned to allow a portion of the pushing member **167** to pass through the opening **180**, but to not allow the stopper **160** to pass through the opening **180**. Similarly, the

opening **180** is preferably dimensioned to allow the user door **106** to be moved a short distance upwardly while the pushing member **167** engages the stopper **160**.

As may be understood from Figure 7, when the door support assembly **150** is in the locked position, a second end **119** of the support rod **109** is adjacent a support member **175**. In one embodiment of the invention, this support member **175** engages the second end **119** of the support rod **109** when the user door **106** is in the fully closed position and thereby at least partially supports the weight of the user door **106**.

In addition, in one embodiment of the invention, when the door support assembly **150** is in the locked position, the pushing member **167** extends through the opening **180** in the user door **106** and engages a support portion of the user door **106** adjacent the opening **180**. This also serves to at least partially support the weight of the user door **106**. Accordingly, in one embodiment of the invention, when the user door **106** is in the closed position, the weight of the door is substantially supported by the support member **175** and the pushing member **167**.

To open the user door **106**, the door linking mechanism **120** is first moved from the locked to the unlocked position as discussed above. The user door **106** is then moved upwardly (preferably a short distance that is less than 3 inches) into a first intermediate position (an example of which is shown in Fig. 8) in which: (1) the user door **106** is a short distance above its fully closed position; and (2) the door support assembly **150** is in the locked position, but the weight of the door is substantially supported by the drive mechanism.

After the user door **106** reaches the first intermediate position, the user door **106** is moved into a second intermediate position (an example of which is shown in Fig. 9) in which: (1) the user door **106** is a short distance above its fully closed position; (2) the door support assembly **150** is in the unlocked position; and (3) the weight of the door is substantially supported by the

drive mechanism. This is done by moving the pushing member **167** into a retracted position (e.g., away from the support rod **109**) in which the pushing member **167** does not engage the stopper **160** and is preferably spaced apart from the user door **106**. Moving the pushing member **167** in this manner causes the second end **119** of the support rod **109** to move into a position in which the support rod's downward path is not substantially obstructed by the support member **175**.

Finally, the user door **106** is moved into an open position (an example of which is shown in Fig. 10) by using the first and second drive chains **111, 116** to move the first and second door movement brackets **112, 117** downwardly until the user door **106** is in a fully open position.

To close the door, the steps above are performed in reverse order. More particularly, the user door **106** is first moved from the open position (see Fig. 10) to a second intermediate position (see Fig. 9). The user door **106** is then moved from the second intermediate position to the first intermediate position (see Fig. 8). Finally, the user door **106** is moved into a closed position and the door linking member **120** is moved into a locked position to prevent users from opening the user door **106** as discussed above. An example of a user door **106** in this configuration is shown in Fig. 7.

Detailed Discussion of Further Embodiments of the Invention

Figure 11 depicts a drive system **500** according to one embodiment of the invention that may be used to open and close one or more sliding user doors. As may be understood from this figure, in one embodiment of the invention, the drive system **500** comprises a motor **501**, first and second bearings **517** and **518**, left idler sprocket axle **513**, right idler sprocket axle **512**, end

of travel switch **509**, unweight switch **541** and home switch **516**. These components are preferably mounted to the dispenser's main door **300**, which is shown in Fig. 1.

The motor **501**, left drive sprocket **502** and right drive sprocket **504** are mounted to the drive shaft **503** so that when the drive shaft **503** is rotated by the motor **501**, the left drive sprocket **502** and the right drive sprocket **504** also rotate. A right drive chain **505** extends around an exterior portion of the right drive sprocket **504** and also extends around a portion of a right idler sprocket **510** that is spaced apart from the right drive sprocket **504**. The right drive chain **505** is tensioned so that when the motor **501** rotates the drive shaft **503**, the right drive sprocket **504** rotates about the central axis of the drive shaft **503** which causes the right drive chain **505** to move around an exterior portion of both the right drive sprocket **504** and an exterior portion of the right idler sprocket **510**.

Similarly, a left drive chain **514** extends around an exterior portion of the left drive sprocket **502** and also extends around a portion of a left idler sprocket **511** that is spaced apart from the left drive sprocket **502**. The left drive chain **514** is tensioned so that when the motor rotates the drive shaft **503**, the left drive sprocket **502** rotates about the central axis of the drive shaft **503** causing the left drive chain **514** to move around an exterior portion of both the left drive sprocket **502** and an exterior portion of the left idler sprocket **511**.

In one embodiment of the invention, four door movement brackets **506** are mounted to the left drive chain **514**. Similarly, four door movement brackets **506** are also mounted to the right drive chain **505**. These door movement brackets **506** are used to move the sliding user doors **401, 402, 403, 404** (see Fig. 1A) relative to the dispenser as described above.

In addition, first, second, third, and fourth switch actuators **507, 508, 515, 540** are mounted to the right drive chain **505**. The first switch actuator **507** is adapted to activate a home

switch **516** when the right drive chain **505** moves into a home position. In one embodiment of the invention, the right drive chain **505** is in a home position when the right drive chain **505** moves a sliding door (e.g., **401 - 404**) into a closed position.

Second and third switch actuators **508, 515** activate an "end of travel" switch **509** when the right drive chain **505** moves a sliding user door **401 - 404** into a fully open position. More particularly, the second switch actuator **508** activates the end of travel switch **509** when the first sliding user door **401** is in a fully open position, and the third switch actuator **515** activates the end of travel switch **509** when any of the second, third, or fourth sliding user doors **402, 403** and **404** are in a fully open position. In one embodiment of the invention, the fourth switch actuator **540** and the unweight switch **541** are associated only with the first sliding user door **401**. These components are described in greater detail below.

In one embodiment of the invention, the drive system is mounted inside the frame of the dispenser's main door **300** (see Fig. 1A – Fig. 3). In this embodiment, the motor **501**, left drive sprocket **502**, right drive sprocket **504**, drive shaft **503**, and bearings **517, 518** are disposed in an upper interior portion **305** of the main door **300** (see Fig. 3). Similarly, in a particular embodiment of the invention, the right idler sprocket **510**, the right idler sprocket axle **512**, the left idler sprocket **511** and the left idler sprocket axle **513** are disposed in a lower interior portion **306** of the dispenser's main door **300**. By the same token, in one embodiment of the invention, the right drive chain **505**, first, second and third switch actuators **507, 508, 515**, the home switch **516**, the end of travel switch **509** and the right-side door movement brackets **506** are disposed within a right interior portion **303** of the dispenser. Similarly, the left drive chain **514** and the left-side door movement brackets **506** are positioned within a left interior portion **304** of the dispenser (see Fig. 3).

Figure 12A depicts a lock/unlock drive mechanism **590**, a user door **402**, a door linking assembly **591**, and a portion of the open/close drive system **500** (see also Fig. 11). The user door **402** is shown in the closed and locked position. As will be understood by one skilled in the art in light of this disclosure, this user door **402** may alternatively be, for example, any one of the second, third, or fourth user doors **402, 403, 404** or any other suitable door.

As may be understood from Figures 12A – 12C, in one embodiment of the invention, the lock/unlock drive mechanism **590** comprises an actuator **550**, an actuator spring return **551** and an actuator arm **552** that includes a switch actuator **573**. The switch actuator **573** is preferably configured to actuate either a "locked" switch **571** or an "unlocked" switch **572** depending on the position of the actuator arm **552**.

In a particular embodiment of the invention, the door linking assembly **591** includes a right lift interface **553**, a wheel **554**, a linking rod **556**, a linking support rod mount **555**, a rotatable member **560**, and a tension spring **558**. A linking support rod mount **555** is mounted to the user door **402** and configured to support the linking rod **556** while allowing the linking rod **556** to slide substantially laterally relative to the user door **402**.

In one embodiment of the invention, one end of the tension spring **558** is attached to the linking rod **556** at an attachment point **557**. The other end of the tension spring **558** is attached to the spring bracket **559**, which is mounted to the user door **402**. The tension spring **558** is preferably configured to bias the door linking assembly **591** to the left.

The rotatable member **560** comprises a left lift interface **564**, a left lock arm **563**, a rotatable member pivot **561**, and a linking rod pivot **562** that pivotably connects the linking rod **556** to the rotatable member **560**. The rotatable member **560** is preferably rotatably mounted to the user door **402** to rotate about the rotatable member pivot **561**.

The dispenser further includes a plurality of door stops **565**, that may be mounted, for example, to the right and left tracks **301**, **302** as shown in Figure 12A, to prevent the second, third, and fourth sliding user doors **402**, **403**, **404** from sliding downwardly beyond the fully closed positions.

Generally speaking, in one embodiment of the invention, when the door linking assembly **591** is in a locked position, the user door **402** is maintained in a locked position by: (1) the wheel **554**, which is disposed within a cutout in the right track **301** when the wheel **554** is in the locked position; and (2) the left lock arm **563**, which is disposed within a cutout in the left track **302** when the left lock arm **563** is in the locked position.

Figures 13A and 13B present side views of the left and right tracks **302, 301** the associated cutouts within these tracks **302**, **301**. In one embodiment of the invention, these cutouts include left channel lifter cutout **352**, left channel locking cutout **353**, right channel locking cutout **351** and right channel lifter cutout **356**. As may be understood from Figures 13A and 13B, when the door linking assembly **591** (see Fig. 12A) is in a locked position, the left lock arm **563** is captured by the left locking cutout **353** and the wheel **554** is captured by the right channel cutout **351**.

It should be noted that, in one embodiment of the invention, when the user door **402** is locked, the right lift interface **553** and left lift interface **564** (see Figs. 12A and 13B) are not engaged with the dispenser's door movement brackets **506**. This serves to further prevent the user door **402** from being opened by the drive mechanism.

Turning again to Fig. 12A, in one embodiment of the invention, a sliding user door **402** is unlocked and opened as follows. An authorized user gains access to an electronic control system that controls the dispenser via one of many methods that are well known in the art (e.g., by using

an ID card, access code, etc.) Next, a control microprocessor (not shown) signals the correct user door to open. Assuming that the correct user door is the sliding user door **402**, the actuator **550** for user door **402** is signaled to operate, which causes actuator arm **552** to move laterally from the position shown in Figures 12A and 12B to the position shown in Figures 14A and 14B. When the actuator arm **552** moves laterally to the right, it pulls the wheel **554** to the right beyond the right channel locking cutout **351** (see Fig. 13B). This, in turn, unlocks the right side of the sliding user door **402**. Also, as the wheel **554** moves to the right, the wheel **554** pulls linking rod **556** to the right which causes the rotatable member **560** to rotate counterclockwise about its pivot **561** (see Fig. 14A). This causes the left lock arm **563** to disengage from the left channel locking cutout **353** (see Fig. 13A), which unlocks the left side of the sliding user door **402**. The rotation of the rotatable member **560** also causes the left lift interface **564** to engage the door movement bracket **506** on the left drive chain **514**. In addition, the lateral movement of the linking rod **556** causes the right lift interface **553** to engage the right door movement bracket **506** on the right drive chain **505**.

Next, an "unlocked door" signal is sent to the microprocessor indicating that the sliding user door **402** is unlocked. In one embodiment of the invention, this signal is generated in response to unlocked switch **572** being actuated by the switch actuator arm **573** as shown in Figure 14A. In response to the microprocessor receiving the "unlocked door" signal, the microprocessor activates the motor **501** (see Fig. 11) which rotates the drive shaft **503** and thereby causes the right and left drive chains **505**, **514** and right and left door movement brackets **506** to move upwardly (see Fig. 14A). This, in turn, moves the sliding user door **402** upwardly. In one embodiment of the invention, as the sliding user door **402** moves upwardly, the wheel **554**

moves away from the actuator arm **552** and onto an exterior surface of the right track **301** as discussed above.

The motor **501** remains activated until the sliding user door **402** is in a fully open position. When the sliding user door **402** reaches this fully open position, the third switch actuator **515** activates the end of travel switch **409** (see Figure 11), which signals the microprocessor to deactivate the motor **501**. This causes the sliding user door to stop moving upwardly.

To close the sliding user door **402**, the microprocessor sends a signal to the motor **501** to rotate in a direction that is opposite to the direction in which the motor **501** rotated to open the sliding user door **402**. This causes the sliding user door **402** to move in a downward direction. The microprocessor determines when to close the door based on any appropriate method such as: (1) the door has been open for a predetermined period of time; or (2) a sensor determines that a user is no longer using the dispenser.

When the sliding user door **402** reaches a fully closed position, the first switch actuator **507** activates a home switch **516** (see Figure 11). The home switch **516** then transmits a signal to the microprocessor. In response to receiving this signal, the microprocessor deactivates the motor **501**. This, in turn, stops the downward motion of the user door **402**.

In this fully closed position, the wheel **554** (see Figs. 14A & 14B) is again positioned over the right channel locking cutout **351** (see Fig. 13B), the solenoid **550** is deactivated, and the tension spring **558** pulls the wheel **554** into the right channel locking cutout **351**. This, in turn, relocks the right side of the sliding user door **402**. At the same time, the left side of the user door **402** is relocked because rotatable member **560** rotates clockwise so that left lock arm **563** re-engages the left channel locking cutout **353**.

The above-described apparatus and techniques are particularly useful in conjunction with user doors, such as the second, third, and fourth user doors **402**, **403**, **404** (see Fig. 1A) which open upwardly. However, for reasons described below, it is often desirable to provide a modified apparatus for use in opening and locking sliding user doors, such as user door **401**, that open downwardly. Such an apparatus (which may also be used on upwardly opening user doors) is described below.

In one embodiment of the invention, first sliding user door **401** (see Fig. 1A) operates in much the same manner as second, third, and fourth sliding user doors **402**, **403**, **404** except that first sliding user door **401** moves downwardly to open and upwardly to close. Because, in one embodiment of the invention, the first sliding user door **401** moves downwardly to open and upwardly to close, it is desirable to have the rotatable member **560** and actuator arm **552** be inverted from the positions described in regard to Figure 12A. Thus, while the left lock arm **563** is described in regard to Figure 12A as being positioned below the left lift interface **564**, in a particular embodiment of the invention shown in Figure 15, the left lock arm **563** is positioned above the left lift interface **564**. This serves to facilitate the movement of the left lock arm **563** past the left channel locking cutout **353** (see Fig. 16A) when the user door **401** is moved downwardly into an open position.

Similarly, while the actuator arm **552** is described as being positioned below the linking rod **556** in Figure 12A, in one embodiment of the invention (shown in Figure 15), the actuator arm **552** is positioned generally above the linking rod **556**. This serves to facilitate the movement of the wheel **554** past the actuator arm **552** when the user door **401** is moved downwardly into an open position.

It should be understood that rather than inverting the rotatable member **560** and the actuator arm **552** as described above, the shape of the rotatable member **560** and the location and shape of the portions of the dispenser that define the left channel locking cutout **353** may be selected so that: (1) the left lock arm **563** may move past the left channel locking cutout **353** (see Fig. 16A) when the user door **401** is moved downwardly into an open position; and (2) the wheel **554** may move past the actuator arm **552** when the user door **401** is moved downwardly into an open position. As will be understood by one skilled in the art, many such configurations are possible and are within the scope of the invention.

Also, as noted above, in one embodiment of the invention (shown in Fig. 15), the first sliding user door **401** includes a door support assembly **600** that supports the sliding user door **401** when the sliding user door **401** is in the closed position. As will be understood by one skilled in the art, this door support assembly **600** is especially useful when the sliding user door **401** is heavy enough to cause the door linking assembly **591** to potentially jam due to the weight of the user door **401**. Accordingly, in various embodiments of the invention, the door support assembly **600** may be omitted.

As may be understood from Figure 15, in one embodiment of the invention, the door support assembly **600** includes a support rod **601**, one or more support rod mounts **602**, a spring **603**, a stopper **604**, a pushing member **605** and an actuator **606**. The support rod **601** is mounted to slide laterally relative to the first user door **401** by the support rod mounts **602**. In one embodiment of the invention, the actuator **606** is mounted to the dispenser's main door (not shown). The stopper **604**, which is preferably mounted adjacent a first end of the support rod **601**, is preferably large enough to physically prevent the stopper **604** from passing through the sliding user door right cutout **701** (see Fig. 17).

When the first sliding user door **401** is locked, the left end of rod **601** extends into a left cutout **700** in the dispenser's left track **302** and the pushing member **605** passes through a hole **609** in the dispensers' right track **301** as shown in Figures 16A-16B. Also, the pushing member **605** extends into the sliding user door right cutout **701** in sliding user door **401** as shown in Figure 17.

To open the sliding user door **401**, the microprocessor first moves the door linking assembly **591** into an unlocked position. The microprocessor then activates motor **501** which moves the sliding user door **401** upwardly until the driving switch actuator **540** engages unweight switch **541** (See Figure 11). Unweight switch **541** then transmits a signal to the microprocessor causing the microprocessor to deactivate the motor **501**. At this point, the weight of the sliding user door **401** is no longer supported by the door latching mechanism **600**. It should be understood that the cutouts **700** and **701** are preferably elongate to allow for this upward movement of the first sliding user door **401**.

Next, as may be understood from Figure **18**, the microprocessor activates the pushing member actuator **606**, which causes the pushing member **605** to withdraw toward the actuator **606** so that the pushing member **605** no longer extends through the sliding user door right cutout **701**. At the same time, the rod **601** is moved to the right due to the biasing force of spring **603** until the stopper **604** engages the right interior side of the sliding user door **401**. At this point, the rod **601** no longer extends through the left cutout **700** or rod end switch **610**. (See Figs. 16A-18).

In response to the rod **601** moving away from the rod end switch **610,** the rod end switch **610** transmits a signal to the microprocessor. This causes the microprocessor to activate the motor **501** (see Fig. 11) to move the sliding user door **401** downwardly until the user door **401** is

in a fully open position in which the second switch actuator **508** activates the end of travel switch **509**. Once the second switch actuator **508** activates the end of travel switch **509**, the end of travel switch **509** transmits a signal to the microprocessor which then deactivates the motor **501** to stop the downward motion of the user door **401**.

To close the sliding user door **401**, the microprocessor activates the motor **501** to move the user door **401** upwardly until the fourth switch actuator **540** activates the unweight switch **541**. The microprocessor then activates pushing member actuator **606** (see Fig. 18) to cause the pushing member **605** to engage the stopper **604** and force the support rod **601** to the left until the support rod **601** passes through the left cutout **700** and engages the rod end switch **610** (see Fig. 16A and Fig. 18).

In response to the support rod **601** moving into engagement with the rod end switch **610**, the rod end switch **610** transmits a signal to the microprocessor. In response to receiving this signal, the microprocessor activates the motor **501** (see Fig. 11) to move the sliding user door **401** downwardly until the user door **401** is in a fully closed position in which the first switch actuator **507** activates the home switch **516**. Once the first switch actuator **507** activates the home switch **516**, the home switch **516** transmits a signal to the microprocessor which then deactivates the motor **501** to stop the downward motion of the user door **401**. The microprocessor then deactivates the door locking actuator **550** which relocks and disengages the door linking assembly **591** from the door movement brackets **506**. After this occurs, the sliding user door **401** is in a closed and locked position.

CONCLUSION

Many modifications and other embodiments of the invention will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Also, as will be understood by one skilled in the art, the dispenser may be used, in either a modified or unmodified form, in many different contexts. For example, the dispenser may be used to dispense linens in a health care facility, towels in a health club, or towels or linens in a hotel environment. Similarly, the dispenser may be used, either in a modified or unmodified form, to dispense items such as fabric items, medical supplies, tools, and office supplies.

Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.